(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
24 June 2004 (24.06.2004)

PCT

(10) International Publication Number
WO 2004/053644 A2

(51) International Patent Classification[7]: G06F

(21) International Application Number:
PCT/US2003/038868

(22) International Filing Date: 8 December 2003 (08.12.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/431,662 8 December 2002 (08.12.2002) US

(71) Applicant *(for all designated States except US)*: IMMERSION CORPORATION [US/US]; 801 Fox Lane, San Jose, CA 95131 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: GRANT, Danny [CA/CA]; 6678 Chateaubriand, Montreal, Québec H2S 2N7 (CA). EID, Jeffrey [US/US]; 105 Shadwell Drive, Danville, CA 94506 (US). ENDO, Shoichi [JP/US]; 20268 Northwest Square, Cupertino, CA 95014 (US).

(74) Agents: ALEMANNI, John, C. et al.; Kilpatrick Stockton LLP, 1001 West Fourth St., Winston-Salem, NC 27101 (US).

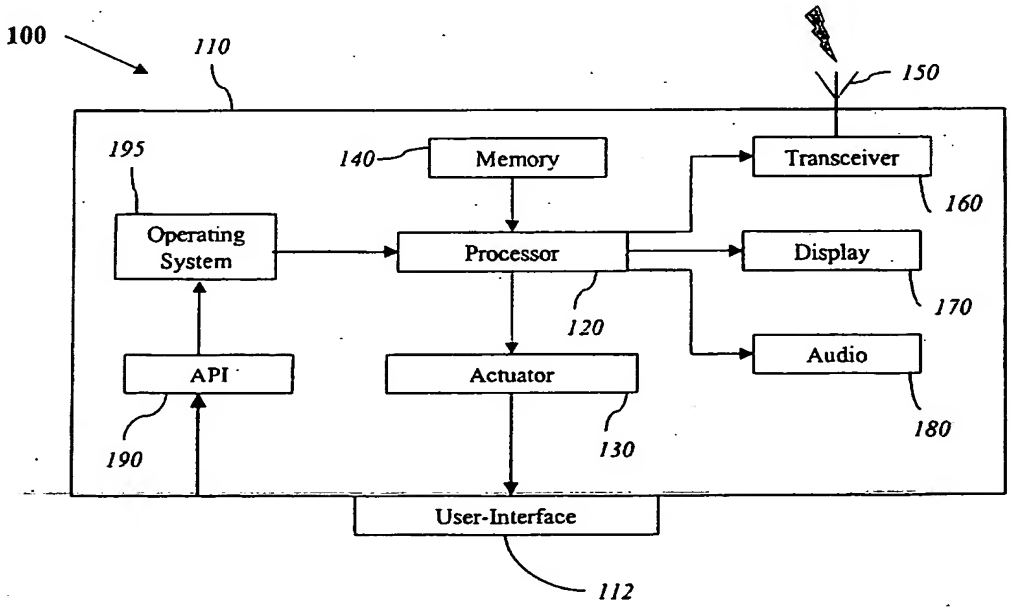
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: USING HAPTIC EFFECTS TO ENHANCE INFORMATION CONTENT IN COMMUNICATIONS



(57) Abstract: Embodiments of the invention relate to methods and systems for providing customized "haptic messaging" to users of handheld communication devices in a variety of applications. In one embodiment, businesses and organizations may each be associated with a distinct haptic logo and include their haptic logos in various messages sent to the handheld communication devices of their customers. In another embodiment, haptically-enabled avatars can be used in a chat session between users of handheld

WO 2004/053644 A2

USING HAPTIC EFFECTS TO ENHANCE INFORMATION CONTENT IN COMMUNICATIONS

INVENTORS

Danny Grant, Jeffrey Eid, and Shoichi Endo

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority to U.S. Provisional Patent Application No. 60/431,662, filed on December 8, 2002, the entire disclosure of which is incorporated herein by reference.

FIELD OF THE INVENTION

This invention relates generally to haptic-feedback systems. More specifically, embodiments of the present invention relate to using customized haptic effects in a variety of applications to convey information to users of handheld communication devices.

BACKGROUND

As handheld communication devices become part of everyday life, device manufactures and service providers strive to enhance the versatility and performance of such devices.

Handheld communication devices in the art (e.g., mobile phones, pagers, personal digital assistants (PDAs), etc.) typically use auditory and visual cues to alert a user when incoming messages, such as voice calls and emails, are received. Such auditory and visual alerts, however, have the disadvantages of being distracting in some situations (e.g., during driving), or annoying in others (e.g., during a meeting or a concert). Although vibratory alerts are made available in some communication devices such as cellular phones, such vibratory effects cannot be customized or personalized according to applications, thus conveying little information to the user. A need, therefore, exists in the art for a new sensory modality that delivers information to users of handheld communication devices in a personalized fashion.

SUMMARY

Embodiments of the invention relate to methods and systems for providing customized "haptic messaging" to users of handheld communication devices in a variety of applications.

In one embodiment, a method of haptic messaging includes: receiving an input signal; extracting a haptic code from the input signal, the haptic code being associated with a haptic logo; and providing a control signal to an actuator, the control signal being based at least in

DETAILED DESCRIPTION

Embodiments described in the following description are provided by way of example to illustrate some general principles of the invention, and should not be construed as limiting the scope of the invention in any manner. One skilled in the art would also recognize that various changes and modifications can be made herein, without departing from the principles and scope of the invention.

FIG. 1 depicts a block diagram of a handheld communication device 100 according to an embodiment of the invention. It will be appreciated that various elements are shown in schematic form for illustrative purposes and are not drawn to scale. It will also be appreciated that many alternative ways of practicing the present invention exit. Accordingly, various changes and modifications may be made herein, without departing from the principles and scope of the invention.

Device 100 includes a device body including a housing 110 and a user-interface 112; a processor 120; at least one actuator 130 in communication with processor 120; and a memory 140 in communication with processor 120. Device 100 also includes an antenna 150 and a transceiver 160, in communication with processor 120. Device 100 additionally includes a display module 170 and an audio module 180, in communication with processor 120. Display module 170 may include, for example, a liquid crystal device. Audio means 180 may include, for example, a speaker, a microphone, and the like.

For purpose of illustration in the embodiment of FIG. 1, processor 120, actuator 130, and memory 140 are shown to be enclosed within and coupled to the device body. Such an illustration, however, should not be construed as limiting the scope of the invention in any manner. In alternative embodiments, actuator 130 may, for example, be coupled to the outside of housing 110, or embedded in housing 110 via a suitable mechanism. Further, user-interface 112 may include one or more user-interface members. As used herein, a user-interface member includes, without limitation, a key pad having one or more keys, one or more buttons, a touch screen or touch pad, a scroll wheel, a direction pad, a trackball, a knob, a miniature joystick, or other user-interface means known in the art.

Device 100 further includes an API (Application Program Interface) 190, working in conjunction with an operating system 195. A device driver (not shown) may optionally provide an interface between operating system 195 and processor 120.

Memory 140 of device 100 stores a program code that includes instructions to cause processor 120 to perform various tasks. The following description provides some examples.

In another embodiment, the input signal may be associated with a reminder event, which may be a self-generated message on the handheld communication device serving as a reminder for a pre-scheduled activity (e.g., an appointment or a meeting). The source in this scenario may be associated with the type of a pre-scheduled activity (e.g., a business meeting vs. a restaurant reservation), or the time at which the pre-scheduled activity takes place.

In yet another embodiment, the input signal may include a communication signal associated with a status event, for example, received via antenna **150** and transceiver **160** of FIG. **1**. Examples of a status event include, but are not limited to: an advertisement (e.g., sale) event, a one-to-one marketing event, a business-transaction event, a stock-trading event, a weather-forecast event, a sports (or game) event, an entertainment event, and an emergency (e.g., 911) event. In this scenario, the source may be associated with a characteristic that distinctly identifies the sender and/or the nature of a status event, such as the phone number of the handheld user's stock broker, the e-mail address of the user's favorite store, the logo associated with the user's favorite TV or radio station, and so on.

In one embodiment, an event of interest can be accompanied by a distinct haptic effect, or overlapping haptic effects, conveying to the user customized information such as "who is calling," "what is happening," and so on. The user can also be allowed to update the haptic lookup table, e.g., to include new events, and/or to modify the mappings between the existing events of interest and the corresponding haptic effects.

Moreover, a specific haptic effect can be assigned to any incoming signal event whose source is unknown, so as to alert the user that the incoming message is from an un-identifiable or sender.

As used herein, the term "handheld communication device" includes, without limitation, a mobile phone such as a cellular phone or a satellite phone, a personal digital assistant (PDA), a cordless telephone, a pager, a two-way radio, a handheld or portable computer, a game console controller, a personal gaming device, an MP3 player, or other personal electronic devices known in the art that are equipped with communication or networking capabilities.

In one embodiment, the aforementioned haptic effects can be used as haptic ringers (e.g., counterparts to auditory ring tones) that are customized or personalized to convey information to the user about various events of interest. By way of example, a haptic ringer associated with a call from a loved one (e.g., the user's spouse) may comprise low-amplitude and high frequency vibrations that impart gentle sensations to the user. In contrast, a haptic

associated with the haptic logo. Step 330 may include providing a control signal to an actuator coupled to the handheld communication device, where the control signal is based at least in part on the haptic code and configured to cause the actuator to output the haptic effect.

In one embodiment, the extracted haptic code may be directly applied to the actuator for rendering the desired haptic effect. In another embodiment, the haptic code may be configured according to a predetermined scheme or protocol that includes, for example, a table of haptic codes (some of which may be associated with one or more haptic logos) versus control signals for rendering the corresponding haptic effects. In this way, a processor in the handheld communication device can look up the corresponding control signal from the table based on the extracted haptic code, and output the selected control signal to the actuator for rendering the desired haptic effect.

In the embodiments of FIG. 2 or 3, the handheld communication device (or the haptic code) may be programmed such that the haptic effect is output immediately, or at a prescribed time after receiving the input signal, as desired in applications. The haptic effects can also be triggered by, or synchronized with, other occurrences.

A handheld communication device may be further configured such that some of its user-interface members (such as those described above) are each associated with a haptic code, e.g., according to a predetermined scheme or protocol. In one embodiment, some of these haptic codes may be associated with haptic effects that emulate expressions or behaviors, such as "laugh," "giggle," "hug," "high-five," "heartbeat," "pet purring," etc. This allows haptic effects to be transmitted and experienced, e.g., in an interactive conversation or a chat session, by pressing or manipulating such members.

By way of example, suppose that user A (termed "Alice" herein) is engaged in a chat session with user B (termed "Bob" herein) via their respective mobile phones. In one embodiment, when Bob tells Alice a joke, Alice can respond by sending a "laugh" sensation to Bob, e.g., by pressing a key on her mobile phone that is assigned with a haptic code corresponding to a laugh sensation. This causes a signal to be transmitted from Alice's phone to Bob's phone, and a corresponding haptic effect to be output to Bob's phone (and thereby experienced by Bob). In alternative embodiments, Alice can include a haptic code in an outgoing message (which may also contain a video image such as a picture taken by her mobile phone, and/or a graphical feature such as an emoticon emulating a smiley face) to be transmitted to Bob, e.g., by pressing the corresponding user-interface member. The haptic code causes a haptic effect to be output when the message is delivered to a remote device

In another embodiment, the input signal of FIG. 5 may be associated with a "virtual touch," e.g., to mimic a handshake, a "high-five," a pat on the back, a pulse or heartbeat sensation, a pet purring sensation, or other touch sensations associated with human (and/or human-animal) interactions. In one scenario, the input signal at step **510** may include a "virtual touch indicator," based on which the request for a contact with a particular user-interface member is made. The virtual touch indicator may be in the form of a haptic code, a message, or other informative means. The control signal at step **530** may be generated, e.g., based on the virtual touch indicator, a haptic code associated with the user-interface member at play, or other predetermined scheme. The input signal at step **510** may also include a virtual touch indicator along with a virtual touch signal for rendering the desired haptic effect. In this case, the control signal at step **530** may be based on the virtual touch signal.

Referring back to the chat session between Alice and Bob, by way of example at the end of their chat session, Alice may wish to send Bob a "high-five." She sends to Bob's mobile phone a signal including a virtual touch indicator, which in turn prompts a request that Bob be in contact with a user-interface member coupled to his phone, such as a direction pad (e.g., by putting his fingers on the individual keys of the direction pad), a key pad, a touch screen, a trackball, a joystick, or the like. The control signal for rendering a haptic effect that emulates a "high-five" may be based on the haptic code associated with the user-interface member, transmitted with the input signal from Alice, and/or other predetermined scheme.

Interactive virtual touch can also be engaged between users of handheld communication devices, where the manipulation of a user-interface member on one handheld communication device is transmitted possibly in substantially real-time to another handheld device and experienced by its user, and vice versa. FIG. 6 depicts a flowchart **600** illustrating a method of providing interactive virtual touch in one embodiment of the present invention. In the embodiment shown, a handheld communication device first receives an input signal including a virtual touch indicator at step **610**. A distinctive haptic ringer may, for example, accompany the arrival of the virtual touch indicator, identifying the sender and the nature of the input signal. The handheld communication device may then perform any necessary initialization to enable the communication at step **620**, which may also include requesting a contact with a particular user-interface member coupled to the handheld communication device at step **625**. The handheld communication device subsequently receives a virtual touch signal in the communication associated with the desired haptic effect at step **630**. The handheld communication device provides the haptic effect at step **640**, e.g., by applying the virtual touch signal to an actuator coupled to the user-interface member.

output the haptic effect. Further, the input signal at step **810** may be received from GPS, a digital compass, or other navigation systems known in the art.

In one embodiment, the haptic effect may be associated with a distance between the position of the handheld communication device and a predetermined location (termed "destination" herein). For example, the haptic effect may include a vibration having a magnitude and a frequency, where at least one of the magnitude and the frequency decreases as the distance from the destination diminishes. Additionally, the haptic effect may be configured to convey a quantitative measure of the distance. By way of example, the haptic effect may include one or more pulse or jolt sensations, where the number of pulses is proportional to the number of miles between the position of the handheld device and the destination.

Processors described above (including processor **120** of FIG. **1**) can include, for example, one or more digital logical processors capable of processing input, execute algorithms, and generate output as necessary to perform various tasks, such as those described above. Such processors/controllers may include a microprocessor, an Application Specific Integrated Circuit (ASIC), and state machines. Such processors include, or may be in communication with, media (including memory **140** of FIG. **1**). Such media include, for example, computer readable media, which stores program code that, when executed by a processor, cause the processor to perform the steps described herein. Embodiments of computer-readable media include, but are not limited to, an electronic, optical, magnetic, or other storage or transmission device capable of providing a processor, such as the processor in a web server, with computer-readable instructions. Other examples of suitable media include, but are not limited to, a floppy disk, CD-ROM, magnetic disk, memory chip, ROM, RAM, ASIC, configured processor, all optical media, all magnetic tape or other magnetic media, or any other medium from which a computer processor can read. Also, various other forms of computer-readable media may transmit or carry instructions to a computer, including a router, private or public network, or other transmission device or channel.

Program code and associated application programs related to various applications may also reside on a remote source, such as a network resource, a Web server, a remote handheld communication device or computer, which can be transmitted or downloaded to a handheld communication device on a regular or predetermined basis. Haptic effects (along with associated control signals) can also be downloaded or transmitted from a remote source, as described above.

configured to provide a third haptic effect that is different from the two mentioned above, e.g., when an e-mail is received from the e-mail address of Bob's stock broker (where the e-mail contains a "smiley-face" emoticon, for instance). The third haptic effect can be a vibration with high magnitude and short duration, e.g., to emulate a "high-five."

In another embodiment, Bob can be watching a movie in a theater with his mobile phone in his pocket. It is set to make no noise, because Bob is in a theater. While Bob is watching the movie, Bob's mobile phone vibrates with the second haptic effect mentioned above. Bob chooses to ignore the call, because he does not wish to speak with his supervisor at a movie theater. Later, Bob's mobile phone vibrates with the first haptic effect. Bob wants to speak with Alice, for example, to make plans to meet later. So Bob answers the phone and quickly exits the theater to talk with Alice.

Bob's mobile phone can also include a personal schedule/calendar application. After speaking with Alice, Bob can enter an entry in the calendar at the 7:00PM time mark -- "Meet Alice". Bob can also choose a fourth haptic effect to associate with the calendar entry. The mobile phone can be programmed to output the fourth haptic effect fifteen minutes before the time entry of the calendar (i.e., at 6:45PM).

Bob's mobile phone can be equipped with GPS capability, along with an associated application program for location determination. Bob can also store addresses of various locations of interest in the application program. In one embodiment, Bob can be on the road. Bob's mobile phone vibrates with a distinct fifth haptic effect. Bob recognizes the fifth haptic effect being associated with the haptic logo of his favorite electronics store. He then checks with the application program, and receives a sixth haptic effect associated with the distance between his current position and the store location. Bob then decides to make a stop at the store.

A haptically-enabled handheld communication device of the invention may be further used as a two-way haptic remote control, for example, for controlling a remote system such as a Television set or a multimedia system. In one embodiment, the events as referred to above may be related to program channels shown on the remote system, each identified by a channel number (which may be used as the "source"), for instance. The corresponding haptic effects may be customized on a per-channel basis. Such haptic effects can serve to inform a user as to which channel is on, as a user is channel-surfing by way of this haptic remote control, so that the user need not to look up the display screen.

FIG. 9 depicts a flowchart illustrating a method for providing haptic effects to a remote control in one embodiment of the present invention. In the embodiment shown, the

That which is claimed is:

1. A method, comprising:

receiving an input signal;

extracting a haptic code from the input signal, the haptic code being associated with a haptic logo; and

providing a control signal to an actuator, the control signal being based at least in part on the haptic code and configured to cause the actuator to output a haptic effect associated with the haptic logo.

2. The method of claim 1 wherein the haptic logo is associated with a status event.

3. The method of claim 2 wherein the status event includes one of an advertisement event, a business-transaction event, a one-to-one marketing event, a stock-trading event, a weather-forecast event, an entertainment event, a sports event, and an emergency event.

4. The method of claim 1 wherein the haptic effect is output to a handheld communication device.

5. A method, comprising:

receiving an input signal associated with a chat message;

causing an avatar associated with the chat message to be displayed on a handheld communication device; and

outputting a control signal to an actuator coupled to the handheld communication device, the control signal configured to cause the actuator to output a haptic effect associated with the chat message.

6. The method of claim 5 further comprising extracting a haptic code from the input signal, the control signal being based at least in part on the haptic code.

7. The method of claim 5 further comprising correlating the haptic effect is with an expression of the avatar.

8. A computer-readable medium on which is encoded program code, comprising:

program code for receiving an input signal;

program code for extracting a haptic code from the input signal, the haptic code being associated with a haptic logo; and

program code for providing a control signal to an actuator, the control signal being based at least in part on the haptic code and configured to cause the actuator to output a haptic effect associated with the haptic logo.

9. The computer-readable medium of claim 8 wherein the haptic logo is associated with a status event.

an actuator in communication with the processor; and

a memory in communication with the processor, the memory storing program code executable by the processor, including:

program code for receiving an input signal;

program code for extracting a haptic code from the input signal, the haptic code being associated with a haptic logo; and

program code for providing a control signal to the actuator, the control signal being based at least in part on the haptic code and configured to cause the actuator to output a haptic effect associated with the haptic logo.

18. The apparatus of claim 17 wherein the actuator is coupled to a handheld communication device.

19. The apparatus of claim 18 wherein the handheld communication device includes one of a cellular phone, a satellite phone, a cordless phone, a personal digital assistant, a pager, a two-way radio, a portable computer, a game console controller, a personal gaming device, and an MP3 player.

20. The apparatus of claim 17 wherein the haptic logo is associated with a status event.

21. The apparatus of claim 20 wherein the status event includes one of an advertisement event, a business-transaction event, a one-to-one marketing event, a stock-trading event, a weather-forecast event, an entertainment event, a sports event, and an emergency event.

22. The apparatus of claim 17 wherein the memory further stores a haptic lookup table associating a plurality of haptic codes each with a control signal.

23. The apparatus of claim 22 wherein the memory further stores program code to download the haptic lookup table from a remote source.

24. The apparatus, comprising:

a processor;

a display module in communication with the processor;

an actuator in communication with the processor; and

a memory in communication with the processor, the memory storing program code executable by the processor, including:

~~program code for receiving an input signal associated with a chat message;~~

program code for causing an avatar associated with the chat message to be displayed on the display module; and

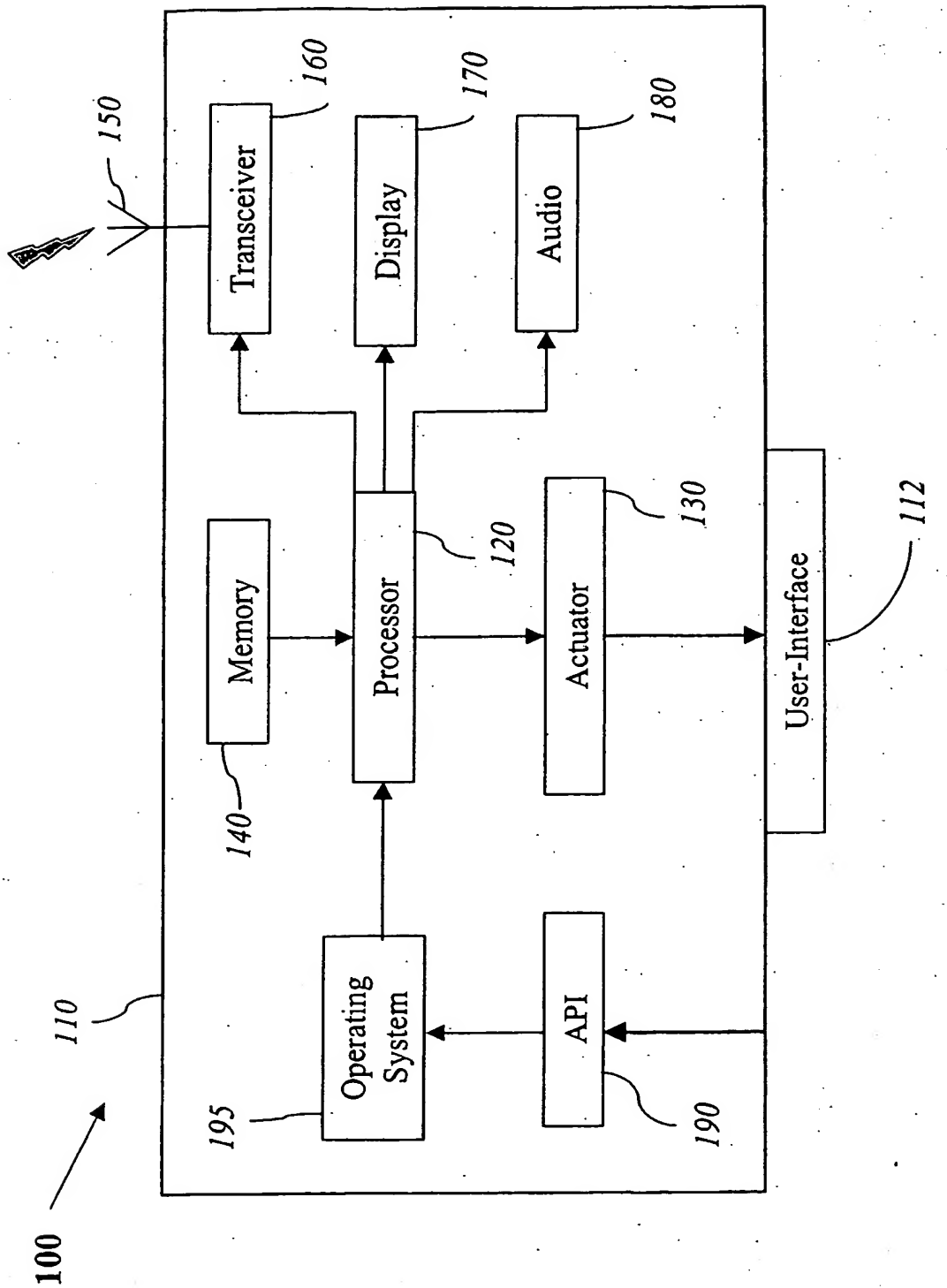

100
110
150
160
Transceiver
170
Display
180
Audio
Memory
140
Processor
120
Actuator
130
User-Interface
112
Operating System
195
API
190

FIG. 1

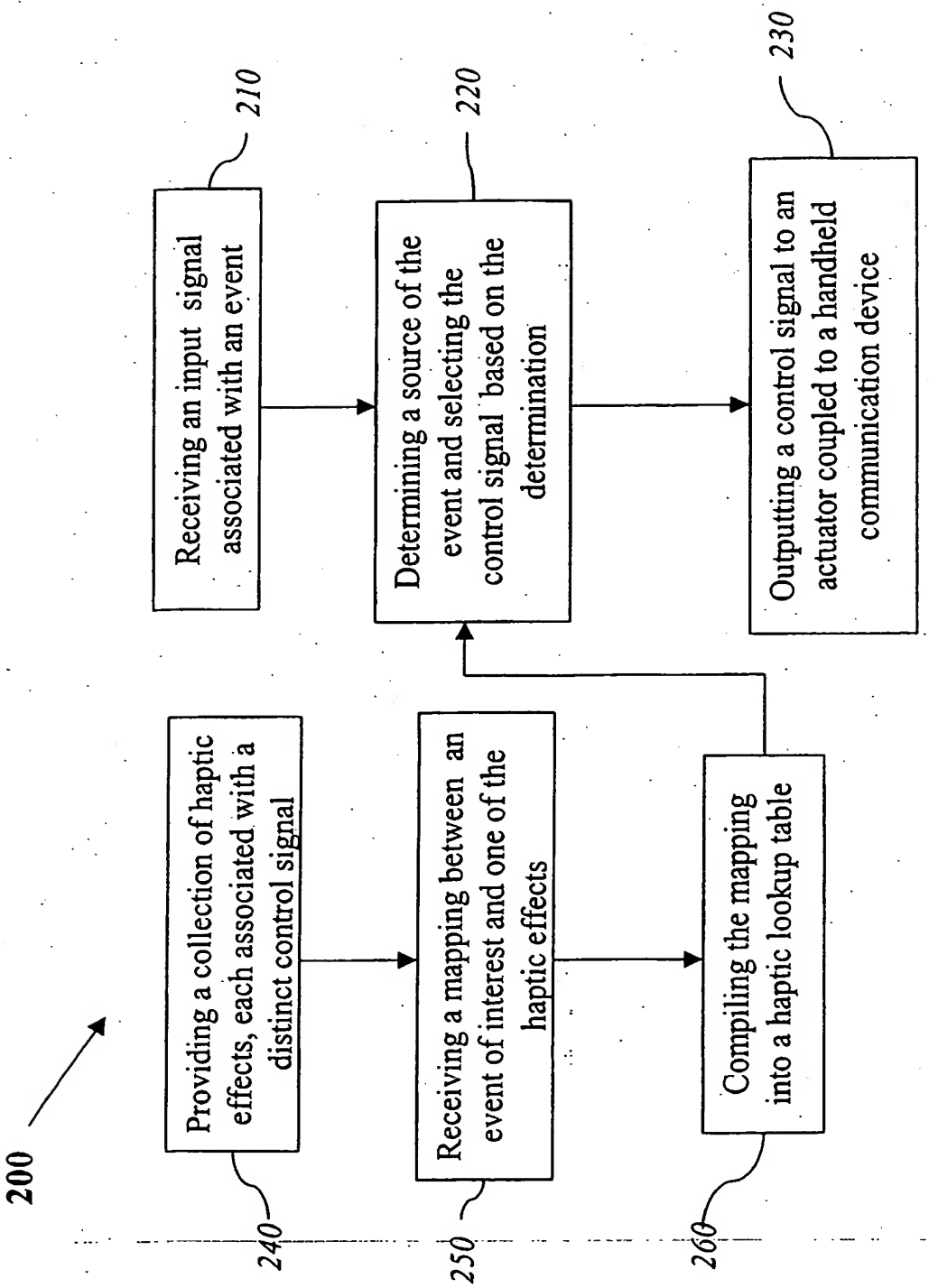

200
Receiving an input signal associated with an event
210
Determining a source of the event and selecting the control signal based on the determination
220
Outputting a control signal to an actuator coupled to a handheld communication device
230
Providing a collection of haptic effects, each associated with a distinct control signal
240
Receiving a mapping between an event of interest and one of the haptic effects
250
Compiling the mapping into a haptic lookup table
260

FIG.2

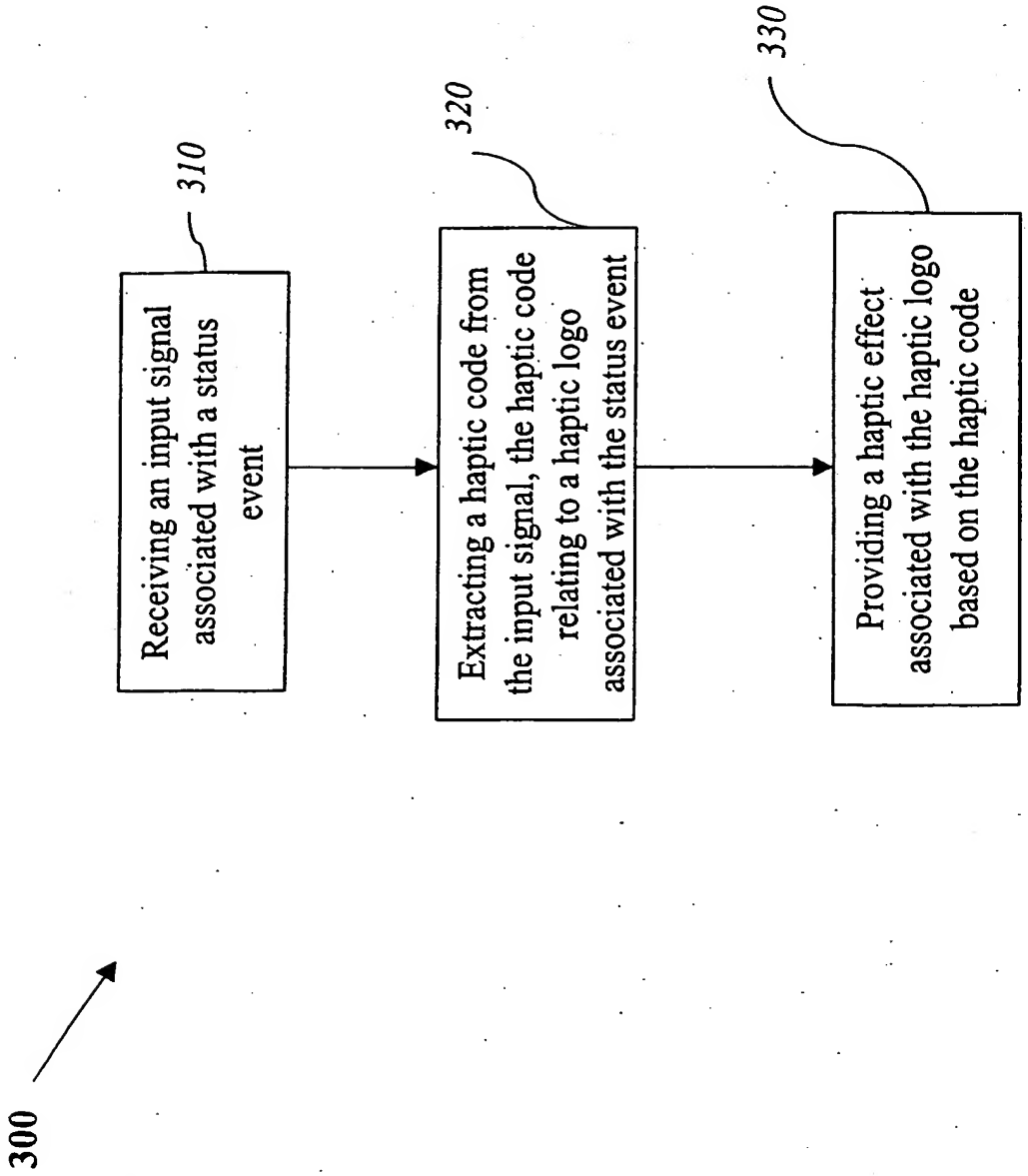

300
310
Receiving an input signal associated with a status event
320
Extracting a haptic code from the input signal, the haptic code relating to a haptic logo associated with the status event
330
Providing a haptic effect associated with the haptic logo based on the haptic code

FIG. 3

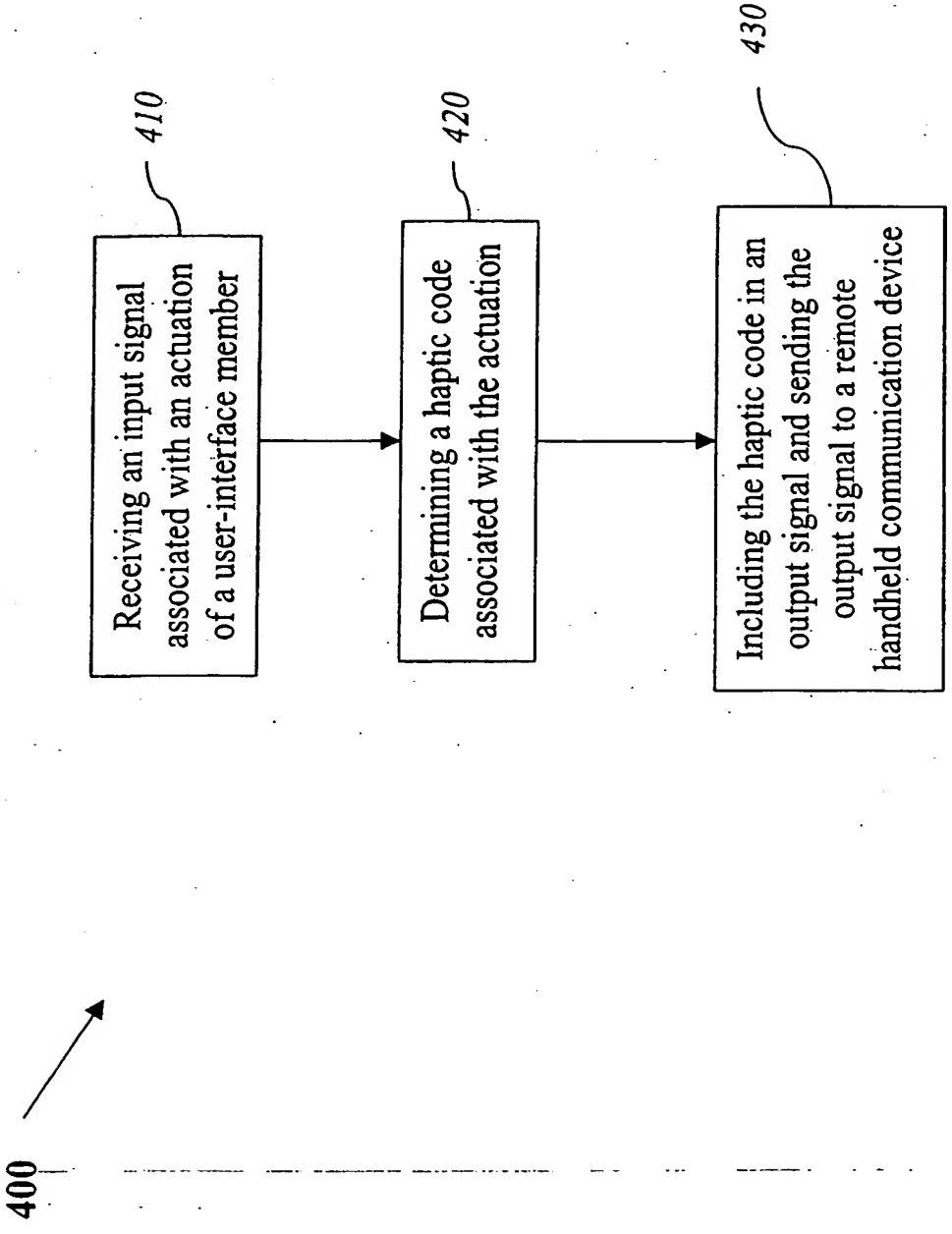

400
410
Receiving an input signal associated with an actuation of a user-interface member
420
Determining a haptic code associated with the actuation
430
Including the haptic code in an output signal and sending the output signal to a remote handheld communication device

FIG. 4

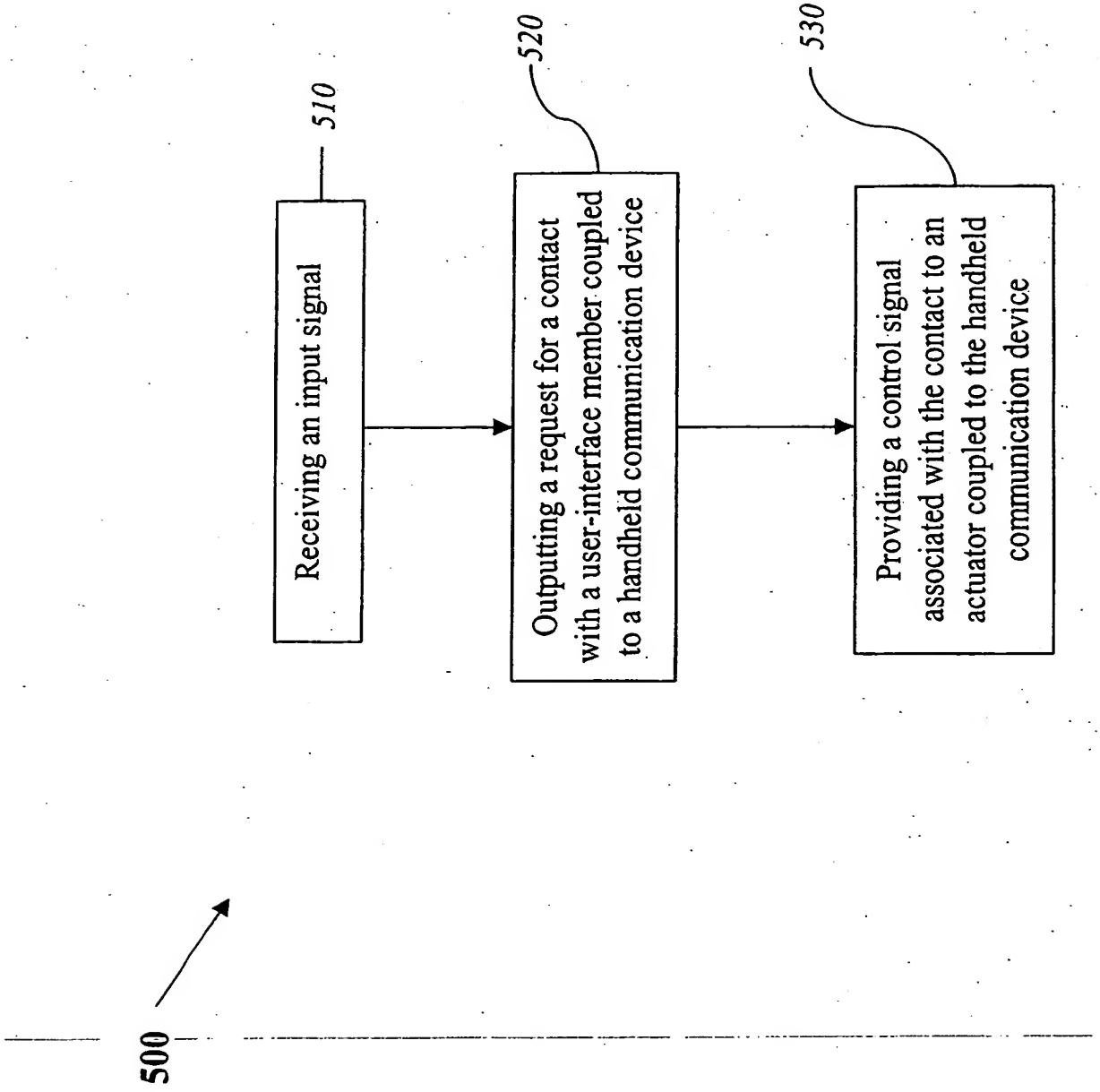

500
510
Receiving an input signal
520
Outputting a request for a contact with a user-interface member coupled to a handheld communication device
530
Providing a control signal associated with the contact to an actuator coupled to the handheld communication device

FIG. 5

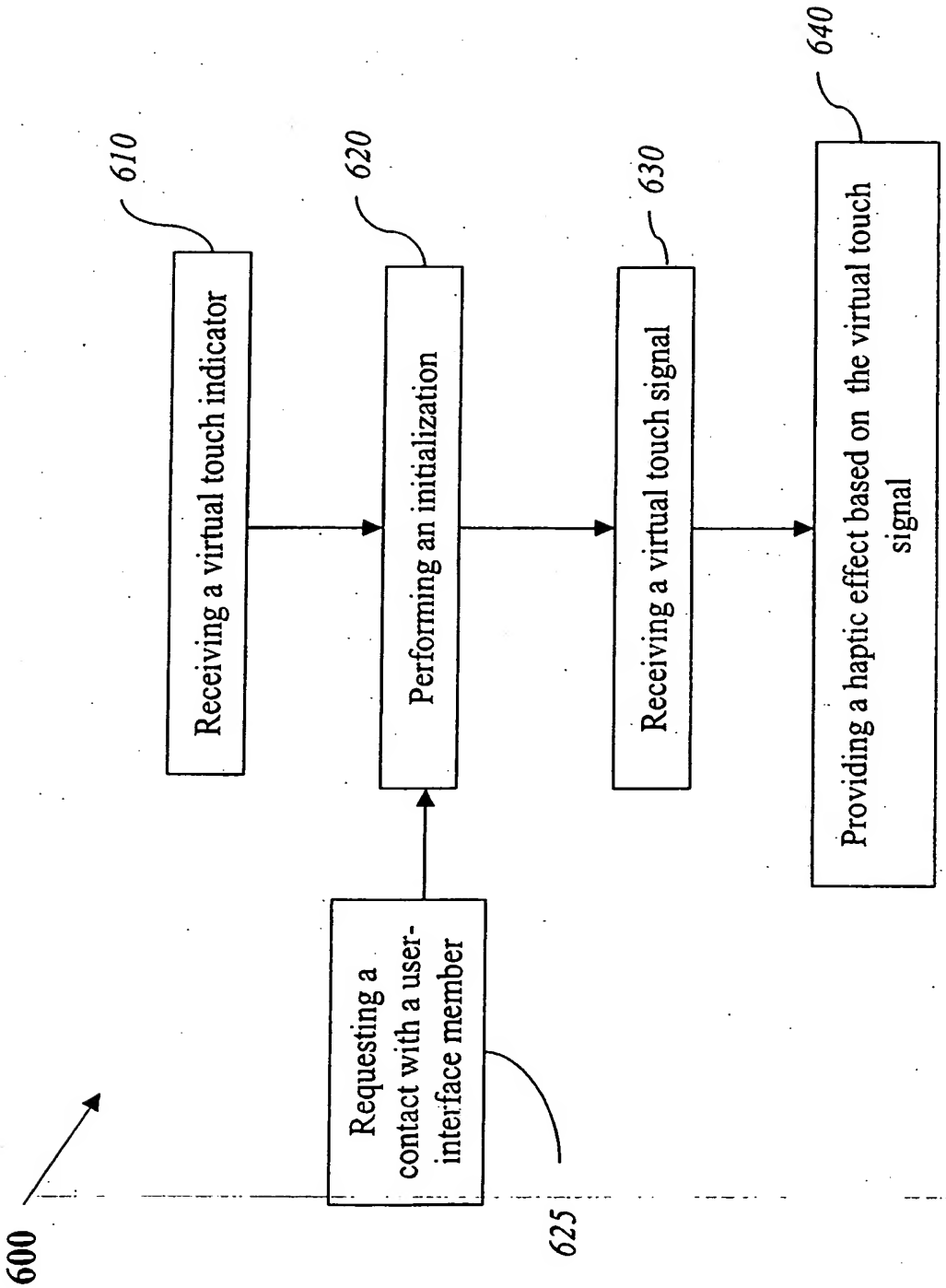

600
610
Receiving a virtual touch indicator
620
Performing an initialization
625
Requesting a contact with a user-interface member
630
Receiving a virtual touch signal
640
Providing a haptic effect based on the virtual touch signal

FIG. 6

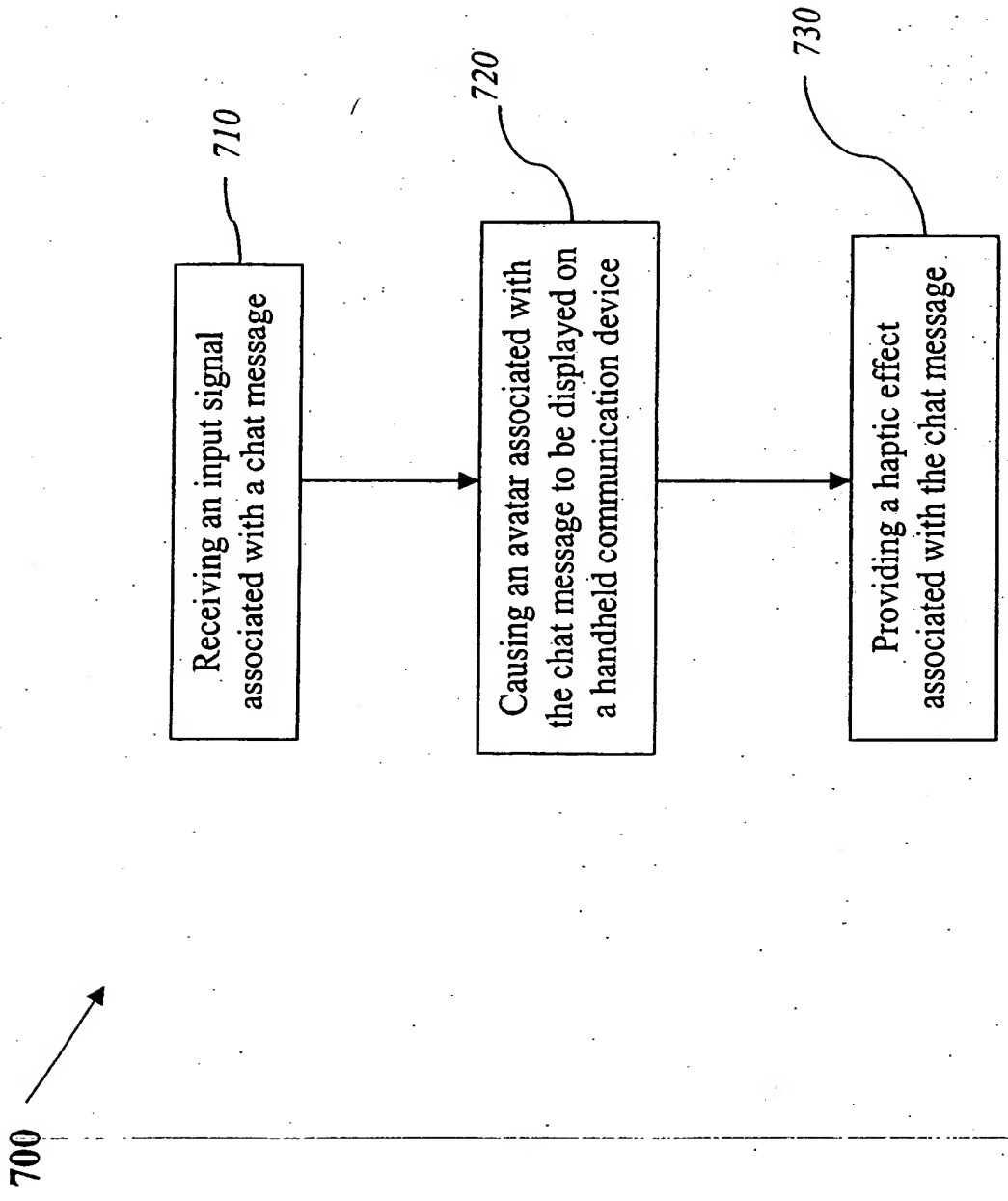

700
710
Receiving an input signal associated with a chat message
720
Causing an avatar associated with the chat message to be displayed on a handheld communication device
730
Providing a haptic effect associated with the chat message

FIG. 7

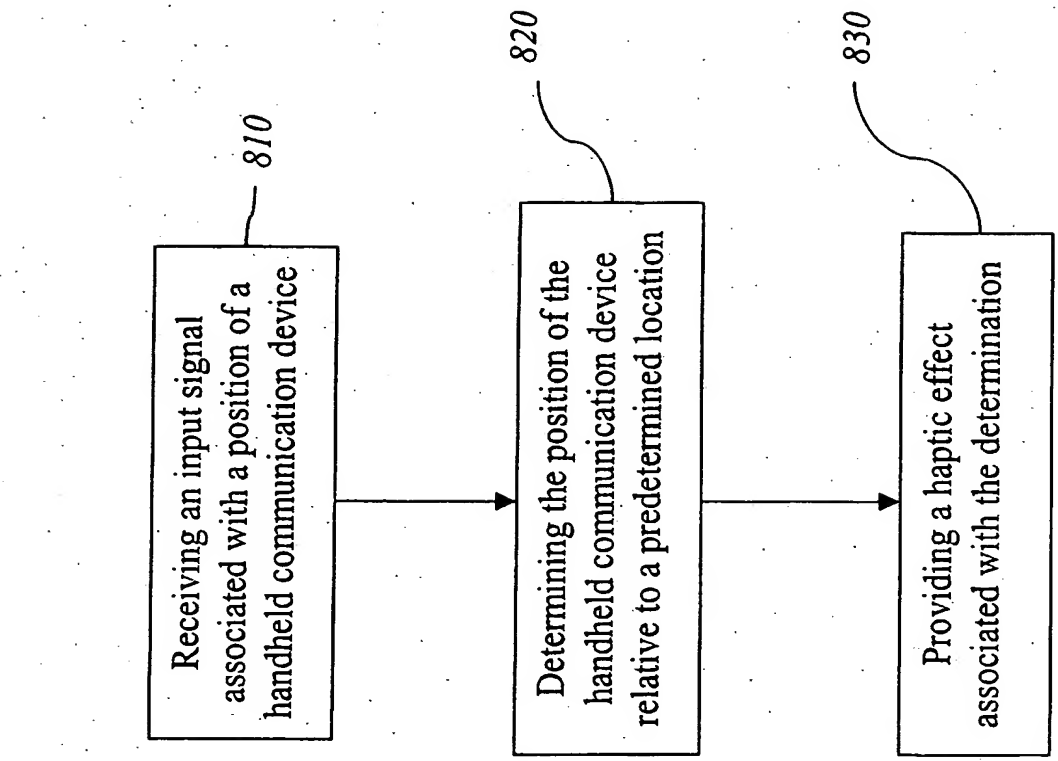

800
810
Receiving an input signal associated with a position of a handheld communication device
820
Determining the position of the handheld communication device relative to a predetermined location
830
Providing a haptic effect associated with the determination

FIG. 8

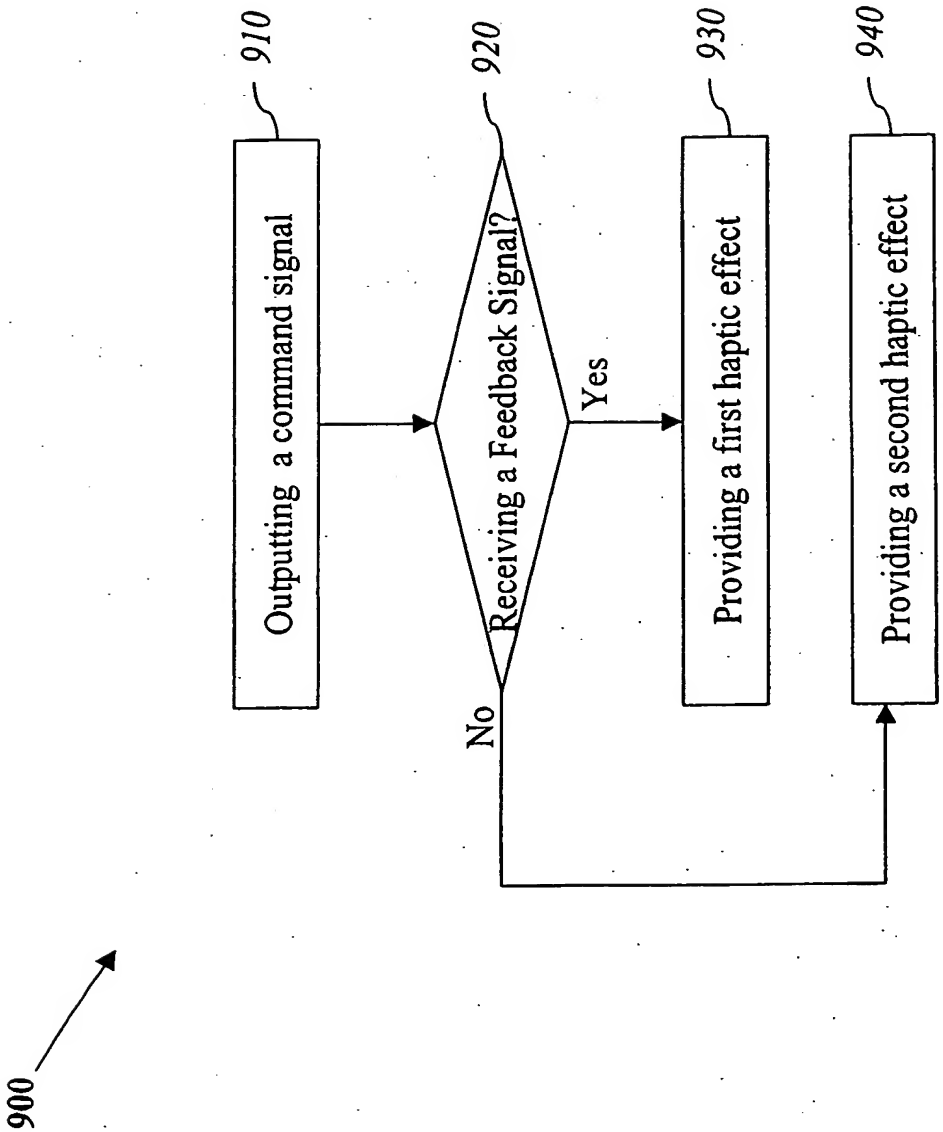

910
Outputting a command signal
920
Receiving a Feedback Signal?
Yes
No
930
Providing a first haptic effect
940
Providing a second haptic effect
900

FIG. 9